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PTO/SB/05 (12/97)

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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No. 042390.P9766 Total Pages 2First Named Inventor or Application Identifier Steven M. BennettExpress Mail Label No. EL627465225US

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, D. C. 20231

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. X Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)
2. X Specification (Total Pages 26)
(preferred arrangement set forth below)
 - Descriptive Title of the Invention
 - Cross References to Related Applications
 - Statement Regarding Fed sponsored R & D
 - Reference to Microfiche Appendix
 - Background of the Invention
 - Brief Summary of the Invention
 - Brief Description of the Drawings (if filed)
 - Detailed Description
 - Claims
 - Abstract of the Disclosure
3. X Drawings(s) (35 USC 113) (Total Sheets 4)
4. X Oath or Declaration (Total Pages 5)
 - a. Newly Executed (Original or Copy)
 - b. Copy from a Prior Application (37 CFR 1.63(d))
(for Continuation/Divisional with Box 17 completed) (**Note Box 5 below**)
 - i. DELETIONS OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
5. Incorporation By Reference (useable if Box 4b is checked)
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4b, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. Microfiche Computer Program (Appendix)
7. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)

jc916 U.S. PTO
09/675907
09/29/00

- a. _____ Computer Readable Copy
b. _____ Paper Copy (identical to computer copy)
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ACCOMPANYING APPLICATION PARTS

8. _____ Assignment Papers (cover sheet & documents(s))
9. _____ a. 37 CFR 3.73(b) Statement (where there is an assignee)
_____ b. Power of Attorney
10. _____ English Translation Document (if applicable)
11. _____ a. Information Disclosure Statement (IDS)/PTO-1449
_____ b. Copies of IDS Citations
12. _____ Preliminary Amendment
13. ☒ Return Receipt Postcard (MPEP 503) (Should be specifically itemized)
14. _____ a. Small Entity Statement(s)
_____ b. Statement filed in prior application, Status still proper and desired
15. _____ Certified Copy of Priority Document(s) (if foreign priority is claimed)
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17. If a **CONTINUING APPLICATION**, check appropriate box and supply the requisite information:

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FEE TRANSMITTAL FOR FY 2000**TOTAL AMOUNT OF PAYMENT (\$)** 1008.00**Complete if Known:**Application No. UnassignedFiling Date HerewithFirst Named Inventor Steven M. BennettGroup Art Unit UnassignedExaminer Name UnassignedAttorney Docket No. 042390.P9766**METHOD OF PAYMENT (check one)**

1. ☐ The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

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- ☒ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

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☒ Check☐ Money Order☐ Other**FEE CALCULATION****1. BASIC FILING FEE**

Large Entity		Small Entity		Fee Description	Fee Paid
Code	Fee (\$)	Code	Fee (\$)		
101	690	201	345	Utility application filing fee	<u>690.00</u>
106	310	206	155	Design application filing fee	_____
107	480	207	240	Plant filing fee	_____
108	690	208	345	Reissue filing fee	_____
114	150	214	75	Provisional application filing fee	_____

SUBTOTAL (1) \$ 690.00**2. EXTRA CLAIM FEES**

			Extra Claims	Fee from below	Fee Paid
Total Claims	<u>29</u>	- 20** =	<u>9</u>	X <u>18.00</u>	= <u>162.00</u>
Independent Claims	<u>5</u>	- 3** =	<u>2</u>	X <u>78.00</u>	= <u>156.00</u>
Multiple Dependent				_____	= _____

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Large Entity		Small Entity		Fee Description
Code	Fee (\$)	Code	Fee (\$)	
103	18	203	9	Claims in excess of 20
102	78	202	39	Independent claims in excess of 3
104	260	204	130	Multiple dependent claim, if not paid
109	78	209	39	**Reissue independent claims over original patent
110	18	210	9	**Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) \$318.00**FEE CALCULATION (continued)****3. ADDITIONAL FEES**

01/10/2000

- 1 -

PTO/SB/17 (6/99)

Patent fees are subject to annual revisions. Small Entity payments must be supported by a small entity statement, otherwise large entity fees must be paid.

See Forms PTO/SB/09-12

Large Entity		Small Entity		Fee Description	Fee Paid
Code	Fee (\$)	Code	Fee (\$)		
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for response within first month	
116	380	216	190	Extension for response within second month	
117	870	217	435	Extension for response within third month	
118	1,360	218	680	Extension for response within fourth month	
128	1,850	228	925	Extension for response within fifth month	
119	300	219	150	Notice of Appeal	
120	300	220	150	Filing a brief in support of an appeal	
121	260	221	130	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive unavoidably abandoned application	
141	1,210	241	605	Petition to revive unintentionally abandoned application	
142	1,210	242	605	Utility issue fee (or reissue)	
143	430	243	215	Design issue fee	
144	580	244	290	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	690	246	345	For filing a submission after final rejection (see 37 CFR 1.129(a))	
149	690	249	345	For each additional invention to be examined (see 37 CFR 1.129(a))	
Other fee (specify) _____					
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SUBTOTAL (3)					\$ 0.00

SUBMITTED BY:

Typed or Printed Name: Thomas S. Ferrill

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Thomas & Tenill

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EL627465225US

Serial/Patent No.: *****

Filing/Issue Date: Sept. 29, 2000

Client: Intel Corporation

Title: CHANGING CHARACTERISTICS OF A VOICE USER INTERFACE

BSTZ File No.: 042390.P9766

Atty/Secty Initials: TSF/mro

Date Mailed: 9/29/2000

Docket Due Date: *****

The following has been received in the U.S. Patent & Trademark Office on the date stamped hereon:

- ☐ Amendment/Response (____ pgs.)
- ☐ Appeal Brief (____ pgs.) (in triplicate)
- ☒ Application - Utility (25 pgs., with cover and abstract)
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- ☐ Application - Rule 1.53(b) Divisional (____ pgs.)
- ☐ Application - Rule 1.53(b) CIP (____ pgs.)
- ☐ Application - Rule 1.53(d) CPA Transmittal (____ pgs.)
- ☐ Application - Design (____ pgs.)
- ☐ Application - PCT (____ pgs.)
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- ☒ Drawings: 4 # of sheets includes 4 figures

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- ☐ Issue Fee Transmittal ☐ Amt: _____
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- ☐ Preliminary Amendment (____ pgs.)
- ☐ Reply Brief (____ pgs.)
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- ☐ Small Entity Declaration for Indep. Inventor/Small Business
- ☒ Transmittal Letter, in duplicate
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PATENT
[042390.P9766]

APPLICATION FOR A UNITED STATES PATENT

for

CHANGING CHARACTERISTICS OF A VOICE USER INTERFACE

by

STEVEN M. BENNETT

EXPRESS MAIL MAILING LABEL

NUMBER EL627465225US

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FIELD OF THE INVENTION

This invention generally relates to a voice processing systems. More specifically, the invention relates to using either or both user-specific contextual information and environmental information to make changes in a voice user interface.

BACKGROUND OF THE INVENTION

A voice processing system comprehends human language thereby allowing a user to give commands or make requests to the system by speaking in a human language and having the system respond by voice.

An airline's departure and arrival voice processing system is an example of a rudimentary voice processing system. Figure 1 illustrates an exemplary static call flow in a voice user interface. Referring to figure 1, the user interface illustrated is typical of the kind of static user interface that a user might encounter when using a voice processing system built using previous technology. The user interface welcomes the user and then presents two options to the user. A first voice prompt **102** asks the user to state whether the user's flight is arriving or departing. The user verbally responds by stating whether the flight is arriving or departing. After receiving the user's response, a voice prompt **104** asks the user to state the flight number of interest. The user states the flight number. The system and the user repeat this process to obtain the flight's departure/arrival date **106** and the flight's arrival/departure city **108**. Next, the voice processing system repeats the information back to the user to ensure that the system comprehends the user's request. The system then retrieves that particular flight's information from a database **110**. Finally, the system communicates the retrieved flight information to the user.

The example voice processing system has a static user interface structure. The system delivers information to the user based on the user's requests or commands, not based on the system possessing knowledge regarding the user. In this example, the voice processing system must complete the full sequence of voice prompts before retrieving the desired information.

5 Thus, the user must take the time to navigate through those successive voice prompts.

This system does not deliver content to the user based on the system having any knowledge about the user. The airline system possesses knowledge about the user's upcoming flight plans, for example, through the user's reservation number or frequent flyer account number. However, the system forces the user to step through the static call flow for each
10 segment of the trip. Thus, if the user has a connecting flight, then the user must give the system the user's information and step through the static call flow again. Additionally, although the airline system possesses knowledge of the user's flight plans, the system does not proactively notify the user of a schedule conflict, such as a flight delay on the second portion of the user's trip, which affects the rest of the user's flight plans.

15 Users of voice processing systems are mobile. The mobile user may access the voice processing system from many locations such as a moving vehicle, a quiet office, a noisy airport, etc.. However, current voice processing systems do not alter their privacy and security requirements or operational characteristics based on environmental characteristics. This is a problem for the mobile user who accesses the system from a variety of devices and in a variety
20 of circumstances. In these situations, the behavior of the system should change to be more useful, understandable, private and secure.

Some voice processing systems allow limited customization of the structure of the voice user interface and the content that is delivered to the user. However, after the user

BRIEF DESCRIPTION OF THE DRAWINGS

The drawings refer to the invention in which:

FIG. 1 illustrates an exemplary static call-flow in a voice user interface;

5 FIG. 2 illustrates an embodiment of a system which dynamically changes the voice user interface of the system and content communicated to the user based upon either or both user-specific contextual information and the environmental information;

FIG. 3 illustrates a flow chart of how the speech module generates a grammar file for an information item in the top database table; and

10 FIG. 4 illustrates a flow chart of a dynamically generated call-flow in the voice user interface.

While the invention is subject to various modifications and alternative forms, specific embodiments thereof have been shown by way of example in the drawings and will herein be described in detail. The invention should be understood to not be limited to the particular
15 forms disclosed, but on the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the appended claims.

DETAILED DISCUSSION

A voice processing system comprehends human language thereby allowing a user to give commands or make requests to the system by speaking in a human language and having the system respond. The discussion below centers primarily around voice processing systems which are telephony-based; that is, the user interacts with the system over a telephone connection using his voice. We note, however, that the invention described here is not limited to telephony systems, but in fact includes all voice processing systems regardless of the type of communication device **202** or transmissive network **204** involved.

The voice user interface is a means by which a user and the system interact, typically, using speech or other audio tones as the communication method. In the telephony environment, this is sometimes referred to as a call-flow.

Content is information that is potentially of interest to a user. Content may be communicated to a user either because the user requests the information or because the system intelligently chooses to present the information to the user. For example, if the system is aware of the user's itinerary and that the user's airplane flight has just been canceled, then the system may choose to present to the user the content that the flight is canceled and the flight times associated with alternative flights. On the contrary, the system would not choose to deliver the content of alternative flight times to other users who are not scheduled to be on the canceled flight.

User-specific contextual information is information that the system knows about a particular user such as the user's identity, current location, current task, calendar, schedule, or other similar information.

A communication device **202** is a device such as a cell phone, a land-line phone, a speakerphone, a wireless headset, or other similar device capable of transmitting a human's voice.

The term audio scene refers to the ambient sound environment at the location of the user. Example audio scenes are a moving vehicle, a quiet office cubicle, or an airport with a noisy background filled with various human voices and non-speech sounds.

Environmental information is information such as details of the user's chosen communication device **202**, details of the communication channel, or audio scene information.

When interacting with a voice-automated system, the user may interrupt the system when the system is speaking to the user. This is referred to as a barge-in. When the user barges-in on the system, the system cuts off the system's output mid-stream. Typically, a user initiated barge-in expedites the user's capability to get to pertinent information in a more timely manner. However, extraneous background noise may cause a false barge-in when the noise level becomes high enough. Sources of this noise include public address announcements, a car horn blowing, a user's cough or rough handling of the phone. A false barge-in may cut off the pertinent information that the user wants to hear. The false barge-in forces the user to request that the system repeat the information. A false barge-in lengthens the call and increases the frustration level of the user. Additionally, the user may become confused. All these factors from a false barge-in directly impact the cost of providing the service.

Heterogeneous information is data that is not all the same type. In an embodiment of the invention, the heterogeneous information sources include the user's e-mail, voice mail, calendar, schedule, flight information, weather information, traffic information, hotel

information, rental car information, sports, stocks, news, personal information manager (PIM) information (contacts, tasks), as well as particular categories of interest selected by the user.

Referring to figure 2, figure 2 illustrates an embodiment of a system that dynamically changes the voice user interface of the system and content communicated to the user based upon either or both user-specific contextual information and environmental information. A user interacts with the system through a communication device **202**. The user's analog or digital voice signal travels to the system across the corresponding transmissive network **204**, such as a Public Switched Telephone Network, a satellite network, or other similar network.

The transmissive network **204** may carry analog or digital signals. The system receives the user's voice signal at a device such as a telephony interface device **206**. If necessary, the telephony interface device **206** converts the user's analog voice signal into a stream of digitized voice data. This digital voice data is sent to the speaker verification module **208** and the speech recognizer **210**. The telephony interface device **206** acts as a call control center by detecting that an incoming phone call has been received. The telephony interface device **206** then communicates that an incoming phone call is occurring to the speech module **212**. The telephony interface device **206** takes the incoming line off-hook, i.e. the telephony interface device **206** answers the phone. The telephony interface device **206** accepts digital audio signals from either the text to speech engine **222** or the pre-recorded voice file **220**. The telephony interface device **206** converts the digital signal to analog, if necessary. The digital data to be transmitted may be in a variety of forms, such as wave, MP3, raw audio files or some other digital form. The speech module **212** may direct a pre-recorded voice file **220** to the telephony interface device **206**, which in turn transmits the pre-recorded voice file **220**

onto the transmissive network **204**. In this instance, the pre-recorded voice file **220** might answer the phone by saying *"Welcome to the System, what can I do for you?"*

Each different type of communication device **202** possesses unique audio characteristics, i.e. channel characteristics, that differ significantly. The telephony interface device **206** may characterize channel characteristics of each communication device **202** and communicate the channel characteristics information to the speech module **212**. The speech module **212** compares these characteristics to the channel characteristics of classes of devices stored in the database **214**. With this method, the speech module **212** estimates the type of communication device **202** that the user is using to communicate with the system. For example, the speech module **212** may estimate that the user is calling from a speakerphone, or that the user is calling from a cell phone. In an alternate embodiment, the user may verbally tell the system the type of communication device **202** that the user is using to communicate with the system. Additionally, the speech module **212** may use the phone number assigned to the communication device **202** or caller id information of the communication device **202** to cross reference information stored in the database **214** to aid in determining details of the communication device **202**. If this method can be used because the caller id information is available and the database has information on the device associated with this number, then this method has been found to be highly accurate.

The telephony interface device **206** or speech recognizer **210** may also estimate the audio scene characteristics associated with user's current location. In an alternative embodiment, the speech recognizer **210** estimates the audio scene characteristics associated with user's current location. The telephony interface device **206** or speech recognizer **210** sends the audio scene information to the speech module **212**. The speech module **212**

compares these characteristics to the channel characteristics of classes of audio scenes stored in the database **214**. In alternative embodiments, the user may tell the system the type of audio scene environment that the user is located within. Additionally, the speech module **212** may use the phone number of the communication device **202** or caller id information to cross
5 reference information stored in the database **214** to aid in determining the audio scene information. If this method can be used because either the caller id information is available and the database has information on the associated device, or the location of the device is fixed and the database has information on the associated location, then this method has been found to be highly accurate.

10 The telephony interface device **206** detects the sound level of the user's voice at the board's input. If the telephony interface device **206** detects a sound above the barge-in level, then the board stops generating sound at the board's output. Outbound sound degrades the quality of the incoming sound due to echo paths in the transmission lines. By cutting off the output, the speech recognizer **210** can do a better job of recognizing the sounds that the
15 system is receiving at the input.

The speech module **212** may set the barge-in threshold through an Application Program Interface (API) in the telephony interface device **206** or an API in the speech recognizer **210**. The speech module **212** may use the acquired environmental information as well as user-specific contextual information to determine the appropriate barge-in level. By
20 appropriately setting the barge-in level, the system reduces false barge-in occurrences.

When signaled by the layer of intelligence **218**, the speech module **212** references the database **214** and sends a notification to the user by directly phoning the user. The layer of intelligence **218** sends this notification command if the layer of intelligence **218** recognizes

that a high priority item from the top database table **216** requires the user's immediate attention. In one embodiment, the layer of intelligence **218** starts with the least intrusive method and upon not receiving a user response in a specified period of time, then the layer of intelligence **218** escalates the intrusiveness of the notification method. Example notification methods include, but are not limited to, sending the user an e-mail, sending SMS messages to the user's cell phone, sending pages to the user, and placing a voice call to the user on his cell phone, office phone, home phone, etc.

The speech recognizer **210** receives the stream of digitized voice data from the telephony interface device **206**. The speech recognizer **210** conducts digital signal processing on the incoming user's voice signal for comparison to a language module in order to send American Standard Code for Information Interchange (ASCII) text (or some other text format) to the speech module **212**. The speech recognizer **210** can access multiple language modules such as an American English module or a Japanese language group. Part of the language module is a grammar file supplied by the speech module **212**. The speech recognizer **210** compares groups of successive phonemes to an internal database of known words and the expected responses in the grammar file. The speech recognizer **210** sends text corresponding to the particular response in the dynamically generated grammar file to the speech module **212**. A portion of the speech recognizer **210** contains adaptive filters that attempt to model and then nullify the communication channel and audio scene noise that is present in the digitized speech signal.

The speech module **212** generates the grammar file sent to the speech recognizer **210**. This grammar file contains anticipated responses based on the prompted options made available to the user and/or statistically frequent responses. The user-specific contextual

information is used in determining the form of this grammar file. Some interactions, such as delivery of information like news, weather, and e-mail, require only static grammar files because user responses/requests are known a priori. For example, the user might say “Read the item,” “Delete the item,” or “Skip the item.” However, in more complex interactions, such as dealing with a flight cancellation, the range of possible user responses are situation dependent requiring the speech module **212** to create a customized grammar file **226**.

The speaker verification module **208** receives the stream of digitized voice data from the telephony interface device **206**. The speaker verification module **208** performs a biometric analysis of the user’s voice to authenticate and verify the identity of the user. In response to a prompt, the user states his or her identity. The speech recognizer **210** communicates the user’s stated identity to the speech module **212**. The database **214** provides the speaker verification module **208** with the necessary voice print to verify that the user is whom the user claims to be. The speaker verification module **208** performs this verification by comparing the characteristics of the user’s voice coming from the telephony interface device **206** to this voice print. After analyzing the comparison, the speaker verification module **208** determines a confidence level in the authenticity of the identity of the user. If this confidence level is above a certain threshold, which is set by the speech module **212**, then the identity of the user is confirmed. After the speaker verification module **208** confirms the identity of the user, the speaker verification module **208** communicates to the speech module **212** that the user’s identity has been properly verified.

As another aspect of the security characteristics of the voice user interface, information items in the database **214** are marked with a privacy level and a security level. The speech module **212** determines a security and privacy rating for a communication to a user based

upon the user's environmental information. For example, if access to a communication device 202 is limited either physically or through a local authentication mechanism such as a Personal Identification Number to access a cell phone, then the communication device 202 will be assigned a high level of security. Communications from the user's office phone are likewise assigned a higher level of security than a public pay phone, for example. If the user is using a communication device 202 with a low level of security, then the speech module 212 changes the voice user interface by adding extra authentication steps. For example, the user is calling from a public pay phone, then the voice user interface may add an extra authentication step such as, "Please state your mother's maiden name." The user is expected to say his mother's maiden name. The user's response will be verified against data in the database 214 and possibly by the speaker verification module 208. In an embodiment, the speech module 212 assumes a high level of security only requiring a user to state the user's name and satisfy a voice print analysis. By default, the speech module 212 eliminates extra steps in the voice user interface and shortens call times whenever possible.

The speech module **212** may change the speaker verification confidence threshold based on channel characteristics. If the communication channel is noisy or in some other way impairs the performance of the speaker verification module **208**, then the speech module **212** may lower the threshold level and add extra authentication steps to the voice user interface as described above. For example, an analog cell phone connection often possesses a noisy communication channel. If the user is communicating to the system through a communication channel or communication device **202** that has a low privacy rating (for example, a speaker phone or an analog cell phone connection, both of which are subject to eavesdropping), then

the speech module **212** may ask the user if sensitive information assigned a high privacy rating should be delivered at this time.

The speech module **212** receives text representing the user's voice communication to determine what grammar file and system prompts should be dynamically generated.

5 Additionally, the speech module **212** analyzes the content of text from the speech recognizer **210** in order to send a request to the database **214** to retrieve the information that the user is seeking. When the speech module **212** receives the desired information, then the speech module **212** communicates the information to the user by sending to the telephone interface device **206** either a pre-recorded voice file **220**, or a dynamically generated computer voice
10 message created by the text to speech engine **222** or some combination thereof.

Data from various heterogeneous information sources is placed in the database **214**. The layer of intelligence **218** assigns a priority level to each piece of information based upon the user-specific contextual information. The layer of intelligence **218** orders items of interest to a particular user from the database **214** into the top database table **216** based on the priority
15 level determined above. The layer of intelligence **218** dynamically organizes the order in which the information items from the database **214** are presented to the user by placing the information items in priority order in the top database table **216**.

For example, a meeting at 2:00 p.m. at the client's headquarters exists on the user's PIM calendar. The driving directions from the user's last known location, the user's office, to
20 the client's headquarters suggest driving on highway 101. The monitored traffic news reports an accident on highway 101 increasing the travel time by 20 minutes. The system may then raise the priority level of the traffic delay information and the potential schedule conflict information so that the system communicates this information to the user immediately after

the user identifies himself. Additionally, if based upon the user-specific contextual information, for example the user is scheduled to be in a meeting until 1:30 p.m., this newly acquired information causes a conflict, then the layer of intelligence **218** may increase the item's priority level and signal the speech module **212** to send a notification to the user by using the telephony interface device **206**.

The layer of intelligence **218** assigns a sensitivity and security level the items in the database **214**. Information items that are confidential or personal in nature, for example, a message from a spouse or an email marked "confidential", may be marked at higher sensitivity levels, meaning that the user may not want others to hear them. The security level is used so that content providers may stipulate the delivery mechanisms that are acceptable to them. For example, a corporate email system may let the user set an outgoing email to a high security level. The high security level indicates to the voice processing system that the item should not be delivered over less-secure delivery channels.

Figure 3 illustrates a flow chart of how the speech module **212** generates a grammar file for an information item in the top database table **216**. In step **302**, the speech module **212** calls for the first item of information in the top database table **216**. In step **304**, the speech module **212** determines the type of the information item such as a news article, schedule reminder, or flight cancellation. The speech module **212** also examines the priority level assigned to that item and any sensitivity level assigned to that item. If the communication device **202** is a low privacy device such as a speakerphone and the sensitivity of the item is high enough, then the speech module **212** may add a prompt to the voice user interface asking the user if it is okay to send the sensitive information at this time. In step **306**, the speech module **212** retrieves the static grammar file **224** for that item type. In step **308**, if the speech

module determines grammar customization is required, then the speech module **212** performs the customization creating a customized grammar file **226**. In step **310**, the speech module **212** delivers the (possibly customized) grammar file to the speech recognizer **210**. The speech recognizer **210** uses the grammar file to increase the system's overall speech recognition and comprehension of the user's actual request/response.

The speech module **212** dynamically determines the call flow of the voice user interface. This dynamic determination is based on factors such as the priority level of the data, the user's location and communication device, the sensitivity level of the data, the current task the user is engaged in, and other factors particular to the user that the system monitors. The speech module **212** may change the voice user interface from a passive posture of simply responding to the user's requests to an active posture of notifying the user of information from the top database table **216** assigned a high enough priority.

Figure 4 illustrates a flow chart of a dynamically generated call-flow in the voice user interface. In step **400**, Carl, the user, connects to the system through his office phone. In step **402**, a prompt welcomes the user. After the prompt, Carl identifies himself. In step **404**, the speaker verification module **208** and speech module **212** authenticate Carl's identity. Additionally, the system determines the user's environmental information. In step **406**, the speech module **212** proactively presents to Carl items from the top database table **216** assigned a high enough priority that require Carl's urgent attention. In step **408**, if no such high priority items exist, then the voice user interface passively prompts Carl, "What can I do for you?"

Thus, based on user-specific contextual information, environmental information, the sensitivity of the information being communicated to the user, and/or the priority level

assigned to the information being communicated to the user, the speech module 212 changes the structure of the voice user interface by: eliminating authentication steps; eliminating non-relevant call-flow steps for items in the top database table 216; changing the voice user interface from passively responding to a user's request to proactively alerting the user to information assigned a high priority level; and changing the order in which information is delivered, even across information types (for example, interleaving email, calendar and stock information without forcing the user to navigate a series of menus to reach these heterogeneous pieces of information.

A further example illustrates the speech module 212 changing the voice user interface to eliminate non-relevant steps based upon the system's knowledge of the user-specific contextual information follows. In this example, Carl connects with a cellular phone to the system and requests the system to give him directions from the airport to his hotel:

System: Welcome to the System. What can I do for you?

Carl: It is Carl Weathersby.

System: Hi Carl. To verify your identity, please say "Mice like green cheese".

Carl: Mice like green cheese.

System: Thank you. No urgent items need attention. What can I do for you?

Carl: I need directions to the hotel.

System: One moment... Before we begin, you will need \$1.25 for a toll during the trip. You may want to have it handy. The directions to the Montgomery Hotel are as follows. Follow the signs out of the airport and tell me when you are nearing the exit out of the airport if I don't speak first.

A moment later

Carl: I am there.

System: Make a left onto highway 1a, heading west toward Boston. Stay on 1a for 12 miles. Tell me when you pass exit 11 if I don't speak first.

15 minutes later...

System: Carl, you are nearing exit 11. You are about to enter the Summer Tunnel. The toll is \$1.25. We will lose this cellular connection while you are in the tunnel. Please call back on the other side.

Carl: Goodbye.

After the tunnel

System: Welcome to the System. What can I do for you?

Carl: It is Carl Weathersby.

System: Hi Carl. Please take exit 11, Commercial Street... Head north on Commercial Street for 2 miles...

When Carl calls back after exiting the tunnel, voice user interface did not force Carl to go through the same authentication steps and the system jumped directly back into the task which was interrupted by the tunnel. The speech module **212** dynamically generated the structure and content of the voice interface based on the user context (in this case, knowledge of Carl's location, current task and prior activity). Additionally, the system was either told or anticipated Carl's context and appropriately increases the priority level of several information items. The increase in the priority level of these information items, such as the toll information, cellular connection information, and anticipatory traffic interchange information, causes the voice user interface to communicate these items without Carl requesting them.

Furthermore, the speech module **212** accesses the database **214** to cross reference Carl's

generic request for directions to the hotel to Carl's itinerary stored in the database **214**. The speech module **212** accesses the database **214** for information known about the user in order to give Carl proper directions to the Montgomery hotel rather than forcing the voice user interface to create a prompts asking Carl, "Directions to what hotel?" and "Where are you
5 now?".

In an embodiment, a computer program directs and controls the operation of the voice user interface. This program can be embodied onto a machine-readable medium. A machine-readable medium includes any mechanism that provides (i.e., stores and/or transmits) information in a form readable by a machine (e.g., a computer). For example, a machine-
10 readable medium includes read only memory (ROM); random access memory (RAM); magnetic disk storage media; optical storage media; flash memory devices; electrical, optical, acoustical or other form of propagated signals (e.g., carrier waves, infrared signals, digital signals, etc.); etc.

Most functions performed by electronic hardware components may be duplicated by
15 software emulation. Similarly, processing capability of a central processing unit (CPU) or digital signal processor (DSP) on any board or device may be transported to a CPU or DSP located on any board or device. For example, in an alternative embodiment the processing of information that occurs in the layer of intelligence **218** could be transported to the speech module **212**. Additionally, the telephony interface **206**, speech recognizer **210** or another
20 component may determine the type of communication device **202** without involving the speech module **212** or the database **214**. Furthermore in an alternative embodiment, the speech recognizer **210** detects and communicates the audio scene and channel characteristics signal to the speech module **212**. Therefore, a person skilled in the art will appreciate that

various deviations from the described embodiments of the invention are possible and that many modifications and improvements may be made within the scope and spirit thereof. The invention is to be understood as not limited by the specific embodiments described herein, but only by scope of the appended claims.

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CLAIMS

I claim:

1. A system comprising:

5 a voice user interface possessing both operational characteristics and security characteristics;
a database to store user-specific contextual information; and
a computer program to use the user-specific contextual information to dynamically change the operational characteristics of the voice user interface.

10 2. The system of claim 1 wherein the changed operational characteristic of the voice user interface is a setting of a barge-in level.

15 3. The system of claim 1 wherein the changed operational characteristic of the voice user interface is a generation of a grammar file.

4. The system of claim 1 wherein the changed operational characteristic of the voice user interface is a reduction of non-speech audio components in the processing of a communication from the user.

20 5. The system of claim 1 further comprising:
the computer program to use the user-specific contextual information to dynamically change the security characteristics of the voice user interface.

25 6. The system of claim 5 wherein the security characteristic of the voice user interface is a biometric analysis to authenticate an identity of the user.

7. The system of claim 1 wherein the user-specific contextual information comprises:

an identity of the user; and
a current location of the user.

8. The system of claim 1 wherein the user-specific contextual information comprises:

an identity of the user; and
a current task of the user.

9. The system of claim 1 further comprising:

the computer program to change the security characteristics of the voice user interface
based upon the sensitivity of the information being communicated to the user.

10. The system of claim 1 further comprising:

the computer program to use environmental information to dynamically change the
security characteristics of the voice user interface.

11. The system of claim 10 wherein the security characteristic of the voice user interface is an
addition of an authentication step to authenticate an identity of the user.

12. The system of claim 10 wherein the environmental information is communicated to the
system by the user.

13. The system of claim 10 wherein the environmental information comprises audio scene
information at the location of the user.

14. The system of claim 13 wherein the environmental information is determined by the
system by comparing the audio scene characteristics at the user's location to known references
and selecting the matching environmental scene.

15. A method comprising:

changing a barge-in level of a voice processing system by using user-specific contextual information; and
changing security requirements of a voice processing system that the system requires from the user based upon user-specific contextual information.

5

16. The method of claim 15 further comprising:

changing the barge-in level of the system by using environmental information.

17. The method of claim 15 further comprising:

10

using a dynamically generated grammar file to enhance the ability of the system to recognize communications from the user.

18. The method of claim 15 further comprising:

using biometric analysis to authenticate an identity the user.

15

19. The method of claim 15 further comprising:

changing security requirements of the system that the system requires from the user based upon environmental information.

20

20. The method of claim 15 further comprising:

changing security requirements of the system that the system requires from the user based upon the sensitivity of the information being delivered to the user.

21. An apparatus comprising:

25

a means for changing the barge-in level of a voice processing system by using user-specific contextual information; and
a means for changing security requirements of a voice processing system that the system requires from the user based upon user-specific contextual information.

30

22. The apparatus of claim 21 further comprising:

a means for changing the barge-in level of the system by using environmental information.

23. The apparatus of claim 21 further comprising:

5 a means for generating a grammar file to enhance the ability of the system to recognize communications from the user.

24. A machine-readable medium that provides instructions, which when executed by a machine, cause the machine to perform operations comprising:

10 storing user-specific contextual information; and
changing security requirements of a voice processing system that the system requires from the user based upon user-specific contextual information.

25. The machine-readable medium of claim 24, which causes the machine to perform the further operations comprising:

15 changing security requirements of the system that the system requires from the user based upon environmental information.

26. The machine-readable medium of claim 24, which causes the machine to perform the further operations comprising:

20 changing security requirements of the system that the system requires from the user based upon the sensitivity of the information being delivered to the user.

27. A machine-readable medium that provides instructions, which when executed by a machine, cause the machine to perform operations comprising:

25 changing the barge-in level of a voice processing system by using user-specific contextual information; and

changing security requirements of the voice processing system that the system requires from the user based upon user-specific contextual information.

28. The machine-readable medium of claim 27, which causes the machine to perform the further operations comprising:

changing the barge-in level of the system by using environmental information.

29. The machine-readable medium of claim 27, which causes the machine to perform the further operations comprising:

generating a grammar file to enhance the ability of the system to recognize communications from the user.

[illegible]

5


```

graph TD
    User((User)) --> 102[PROMPT  
"HELLO, PLEASE  
SAY ARRIVAL OR  
DEPARTURE"]
    102 -- DEPARTURE --> 104["PLEASE SAY  
FLIGHT  
NUMBER"]
    102 -- ARRIVAL --> Box1[ ]
    104 -- FLIGHT #497 --> Box2[ ]
    104 -- FLIGHT #461 --> 106["PLEASE SAY  
DATE"]
    104 -- FLIGHT #865 --> Box3[ ]
    106 -- JULY 2ND --> 108["PLEASE SAY  
CITY"]
    106 -- JULY 3RD --> Box4[ ]
    108 -- SAN FRANCISCO --> 110[GET FLIGHT  
DATA FOR THIS  
PARTICULAR  
FLIGHT]
    110 --> DB[DATA  
BASE]
  
```

Figure 1

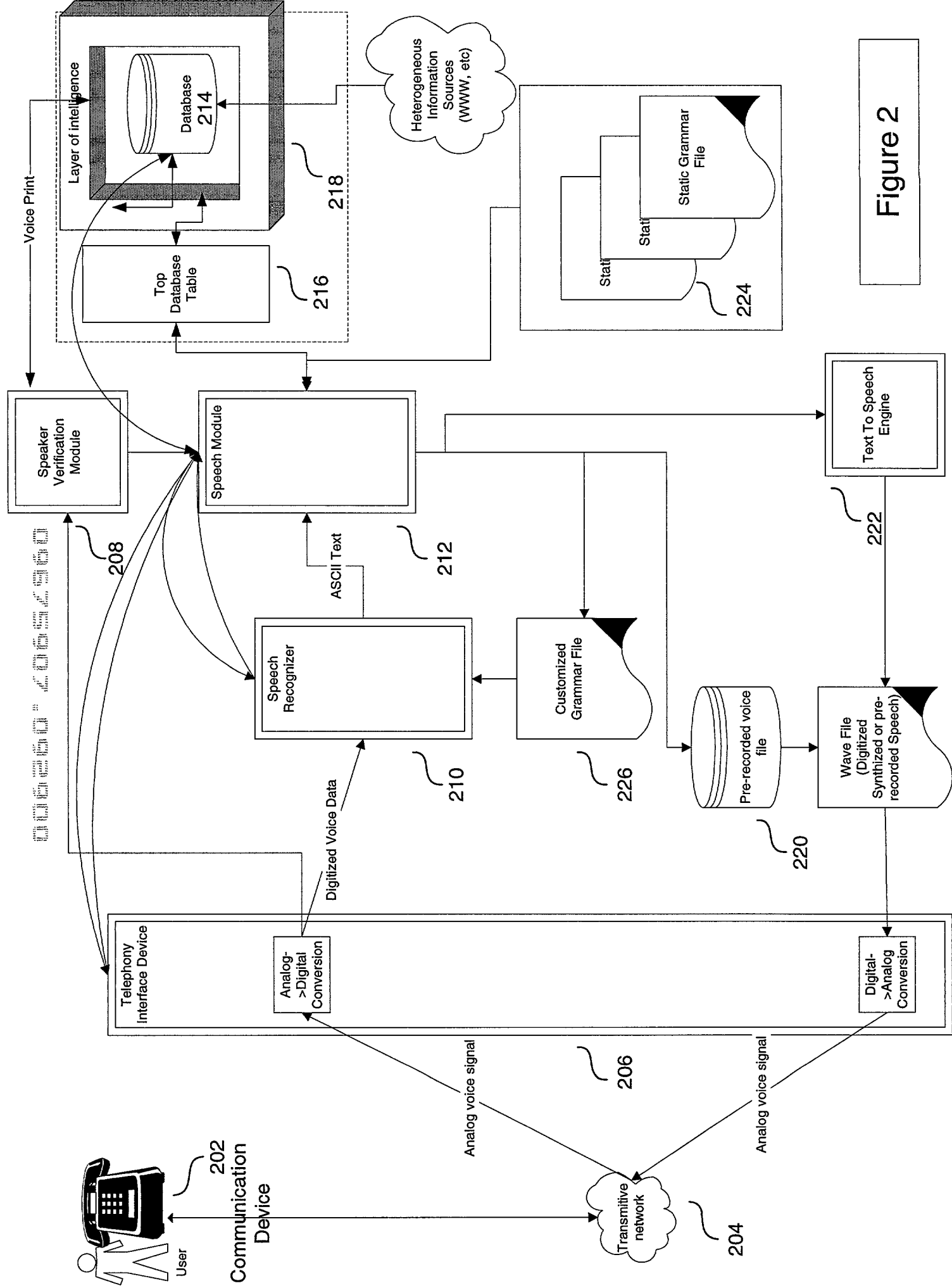


Figure 2

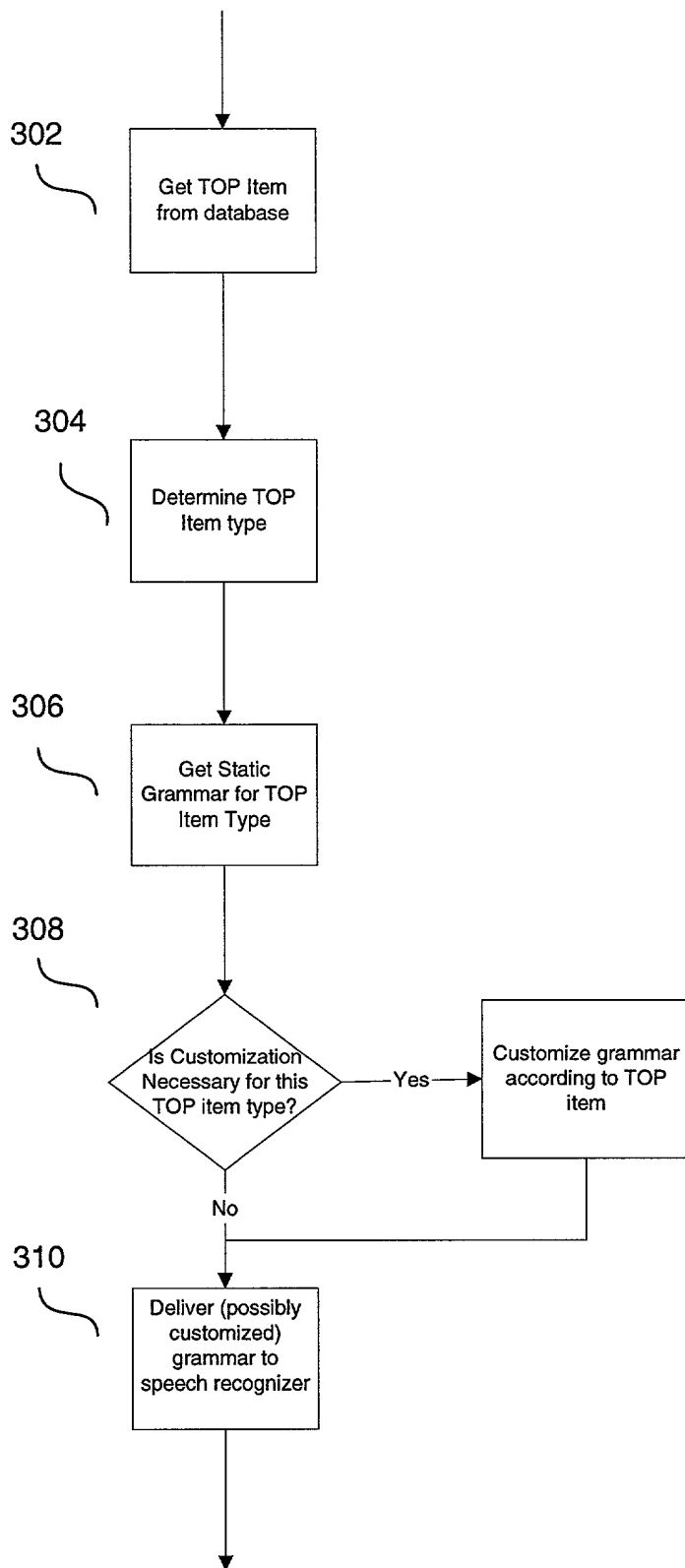


Figure 3

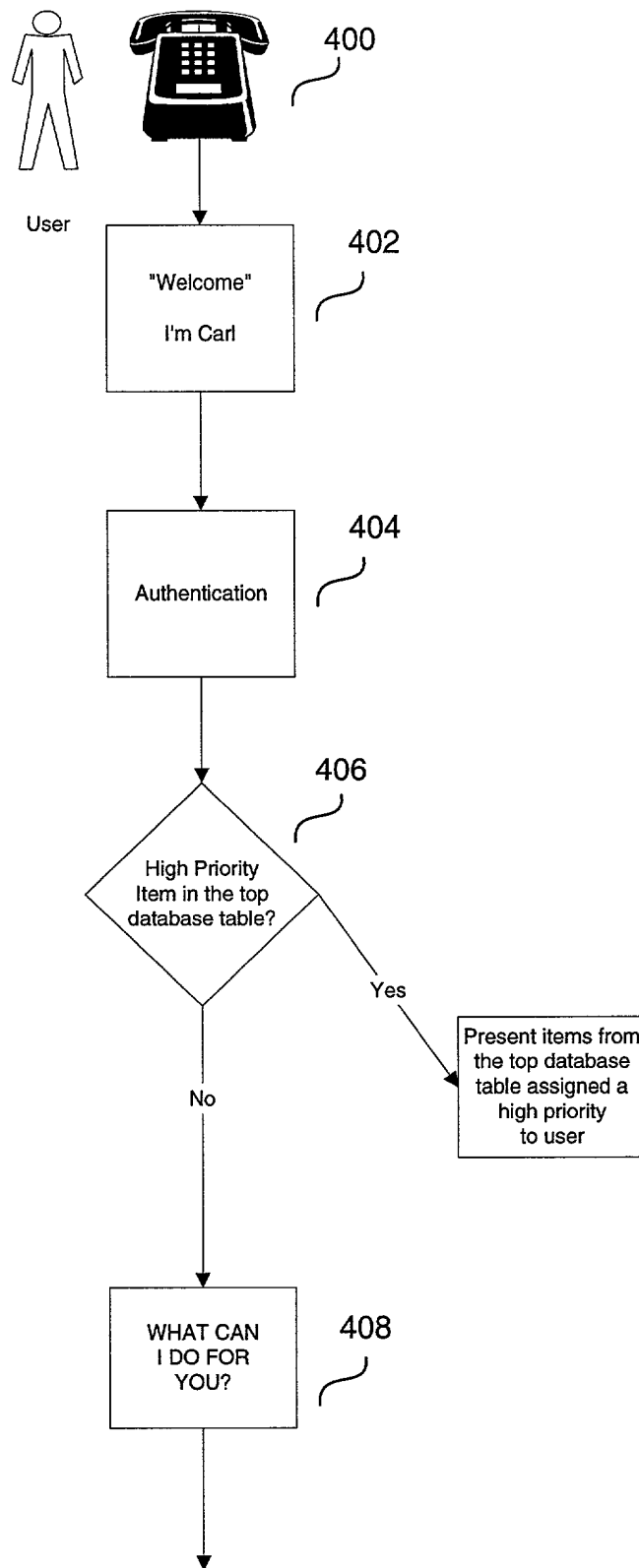


Figure 4

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION
(FOR INTEL CORPORATION PATENT APPLICATIONS)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

CHANGING CHARACTERISTICS OF A VOICE USER INTERFACE

the specification of which

X is attached hereto.

 was filed on _____ as

United States Application Number _____

or PCT International Application Number _____

and was amended on _____.

(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Priority
Claimed

I hereby claim the benefit under Title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below:

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Application Number	Filing Date	Status -- patented, pending, abandoned
Application Number	Filing Date	Status -- patented, pending, abandoned

I hereby appoint the persons listed on Appendix A hereto (which is incorporated by reference and a part of this document) as my respective patent attorneys and patent agents, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

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(Name of Attorney or Agent)
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telephone calls to Thomas S. Ferrill, (408) 720-8300.
(Name of Attorney or Agent)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole/First Inventor Steven M. Bennett

Inventor's Signature _____ Date _____

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(City, State) (Country)

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APPENDIX A

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APPENDIX B

Title 37, Code of Federal Regulations, Section 1.56 Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclose information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclose all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

- (1) Prior art cited in search reports of a foreign patent office in a counterpart application, and
 - (2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.
- (b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and
- (1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or
 - (2) It refutes, or is inconsistent with, a position the applicant takes in:
 - (i) Opposing an argument of unpatentability relied on by the Office, or
 - (ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

- (1) Each inventor named in the application;
- (2) Each attorney or agent who prepares or prosecutes the application; and
- (3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.